Space Weather Technical Forecast

Issued on Tuesday, 16 November 2021 at 00:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1 Minor Geomagnetic Storms Likely Day 1 (16th). Chance of Active Electron Fluence day 2 onward

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity was Very Low, with no notable flares in the last 24 hours. There are three small and simple sunspot regions on the Earth-facing disc. AR2894 Hsx/alpha in the southwest remains a mature and stable sunspot. AR2896 Hsx/alpha near is also mature and stable. A new region Axx/alpha has also rotated onto the northwest disc during the last 24 hours. No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Background solar wind speeds of 300 km/s were measured by DSCOVR at L1 until 15/1500 UTC when they quickly climbed peaking at elevated speeds of 525km/s by 16/0000 UTC. The density was above average at first and climbed throughout to reach well above average, peaking 65 ppcc at 15/2004 UTC, before quickly declining to 10-15 ppcc. The Interplanetary Magnetic Field strength, Bt was initially weak, but become Moderate from 15/1500 UTC and Strong from 15/1800 UTC, peaking 23nT at 15/2017 UTC, before declining back to Moderate levels. The north-south component, Bt, also became Moderate to strong from similar times, but varied between positive and negative values with peaks +19 nT at 15/2017 UTC and -17 nT at 15/1937 UTC. The phi angle was initially negative (towards the Sun), became positive (away from the Sun) around 15/1000UTC, then showed rotations between the two from 15/1930 UTC. These parameters are consistent with the arrival of a strong CIR (co-rotating interaction region) ahead of CH19/-. Geomagnetic activity was Quiet, but became Active 15/1800-2400 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels. The high energy electron flux (greater than 2 MeV) reached High levels between 14/1405-1715 UTC, peaking at 2750 pfu at 15/35 UTC and again 15/1605 UTC, before dropping out to background 15/2100 UTC onward. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), on a fairly steady trend, with 3.73e7 integrated pfu recorded at 16/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Very Low, with a slight chance of C-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Current elevated to solar winds could become strong for a time, due to the ongoing fast wind influence likely from coronal hole 19. These conditions easing day 2 onward with no further enhancement expected. Geomagnetic Activity is expected to be Active to G1/Minor Storm at first, easing to Unsettled to Active, with a decreasing chance of G1 Minor storm intervals by day 2 (17th). Activity then easing to be Quiet to Unsettled day 3 (18th) onward.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at background levels. The high energy electron flux (greater than 2 MeV) is expected to rise in response to recent solar wind enhancement, becoming Moderate to High

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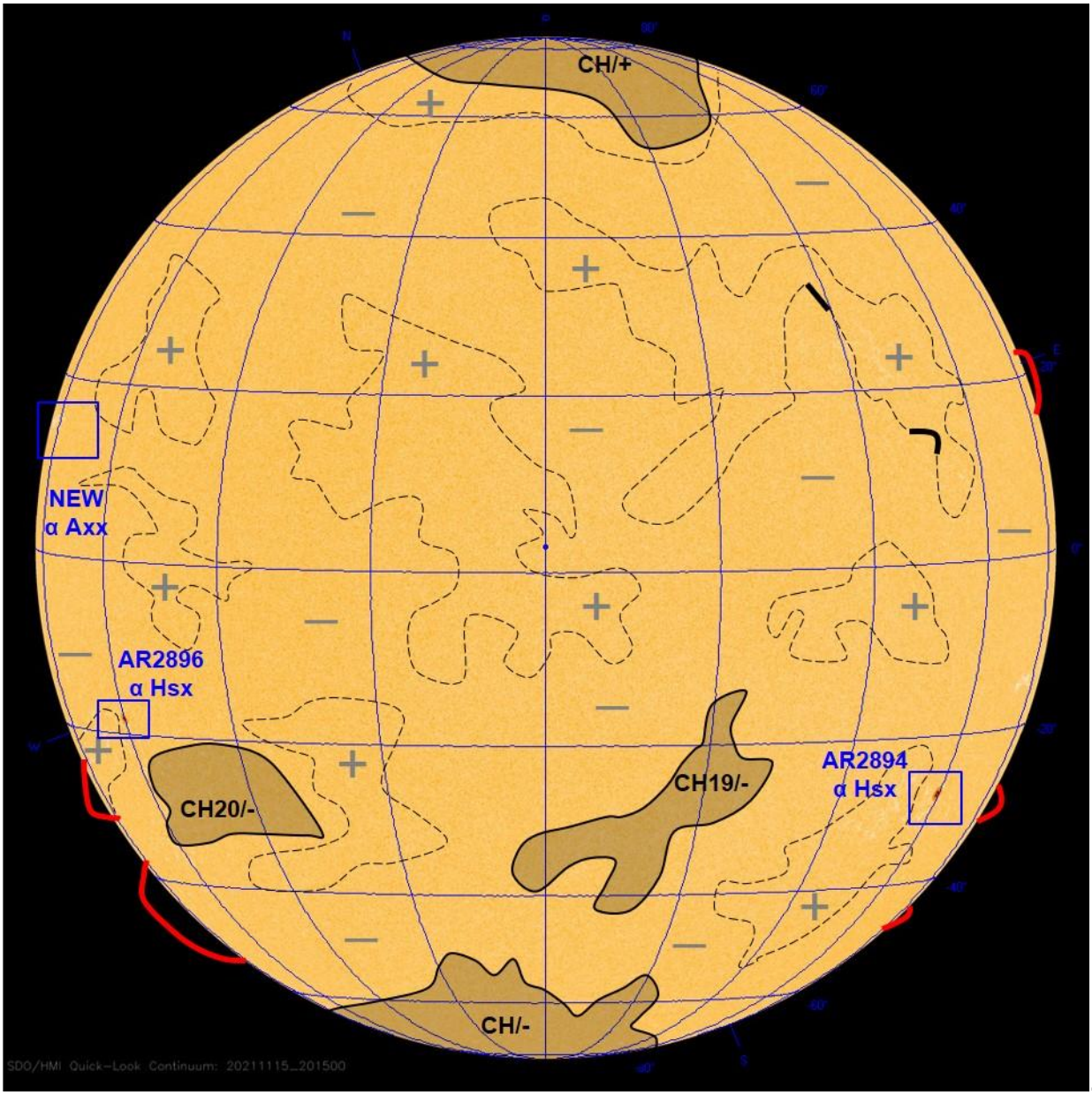
(greater than 1000 pfu) with a chance of becoming persistently High. The corresponding 24-hour electron fluence is expected to rise in response day 1 (16th), likely above the Active (1e8 integrated pfu) threshold day 2 (17th).

Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs. Solar winds have recently become elevated, likely due to the early arrival of the fast wind of coronal hole 19, although confidence is only moderate regarding this source as this is around 30 hours earlier than originally anticipated. Elevated to strong solar winds are expected day 1 (16th), with further periods of above average to strong negative Bz possible. Whilst the strength of the field is expected to ease through the 16th, solar winds speeds are only expected to gradually decline day 2 onward. No further enhancement are expected during this period.

Geomagnetic Activity is expected to be Active to G1/Minor Storm at first, easing to Unsettled to Active, with a decreasing chance of G1 Minor storm intervals by day 2 (17th). Activity then easing to be Quiet to Unsettled day 3 (18th) onward.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Current Geomagnetic Activity (from BGS)

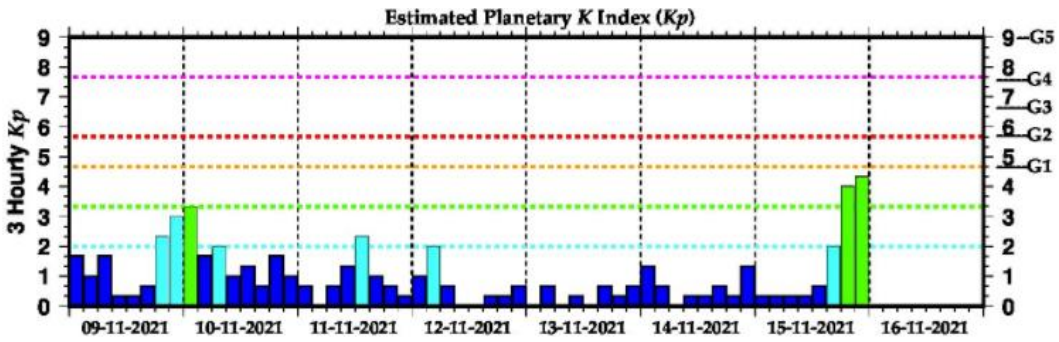

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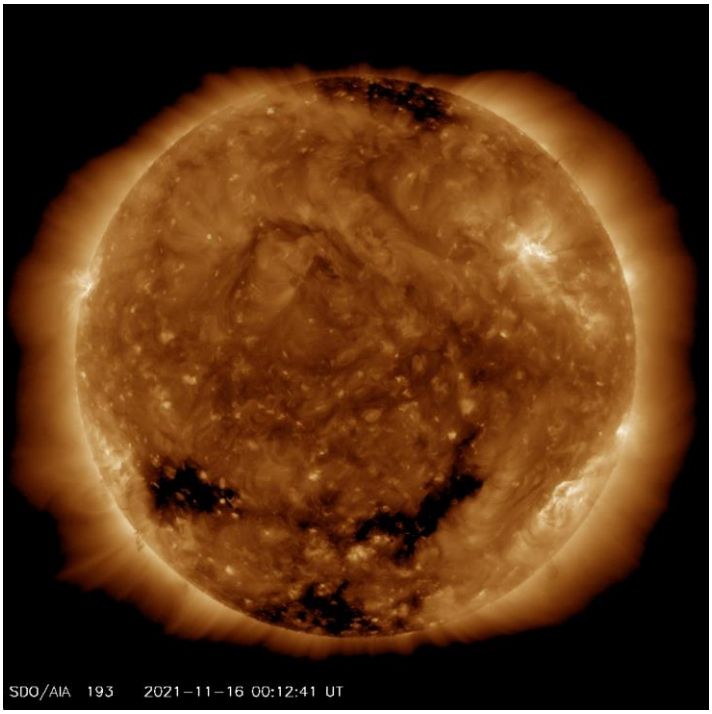
Figure 3: Observed solar winds (DSCOVR at L1)

Figure 4: SDO aia-193 showing CH19/- in southern centre disc



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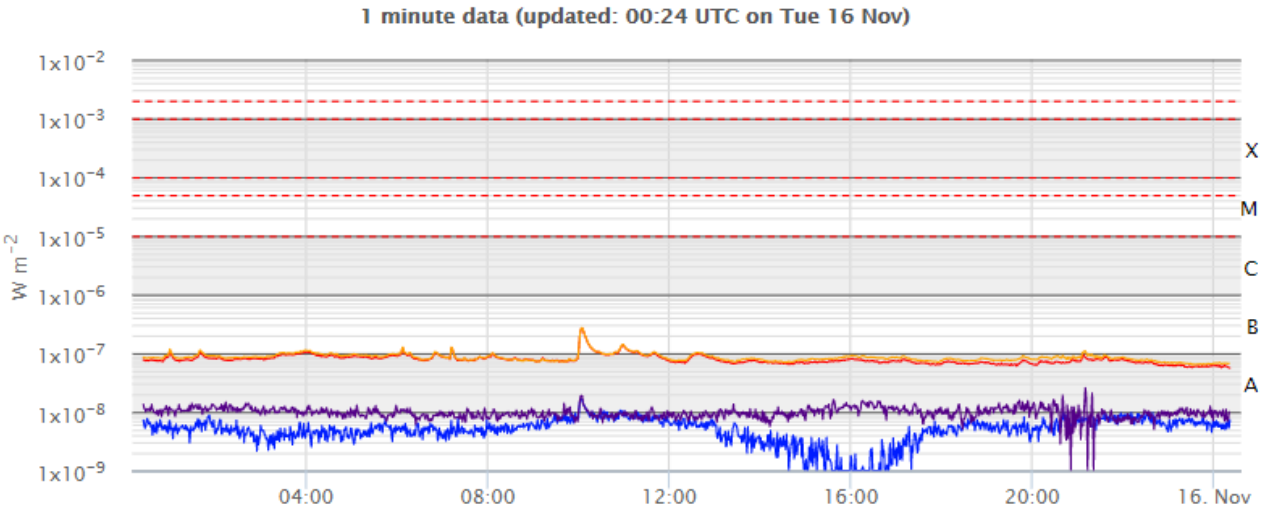
Radio Blackouts - X-Ray Flares:

Solar Activity is currently Very Low with sunspot containing active regions on the Earth-facing disc. These are small and simple regions, with the largest feature, AR2894 Hsx/alpha having persisted as a mature region as it has traversed across the southern solar hemisphere, now approaching the southeast limb. AR2896 Hsx/alpha is another mature feature, in the southwest, while a new unnumbered region has rotated onto the northeast quadrant in the last 24 hours. Solar activity is expected to continue Very Low, with only a slight chance of rising to Low with any C-flares that occur.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 5: GOES-16/17 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as measured by GOES-16 at GEO has been varying between Background and High (greater than 1000 pfu) during the past few days, but dropped out late on the 15th due to enhanced solar winds, likely from the early arrival of the fast wind of CH19/-. Once these elevated conditions subside, Moderate to high flux levels are likely return, potentially becoming persistently High, although this is low confidence.

The associated 24 hour electron fluence is expected to rise later day 1, likely becoming Active (greater than 1e8 integrated pfu) day 2 (17th), and then persisting thereafter. REFM currently doesn't take account of this recent solar wind enhancement, and should be disregarded, especially from the 17th onward.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	70	70	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	5	1

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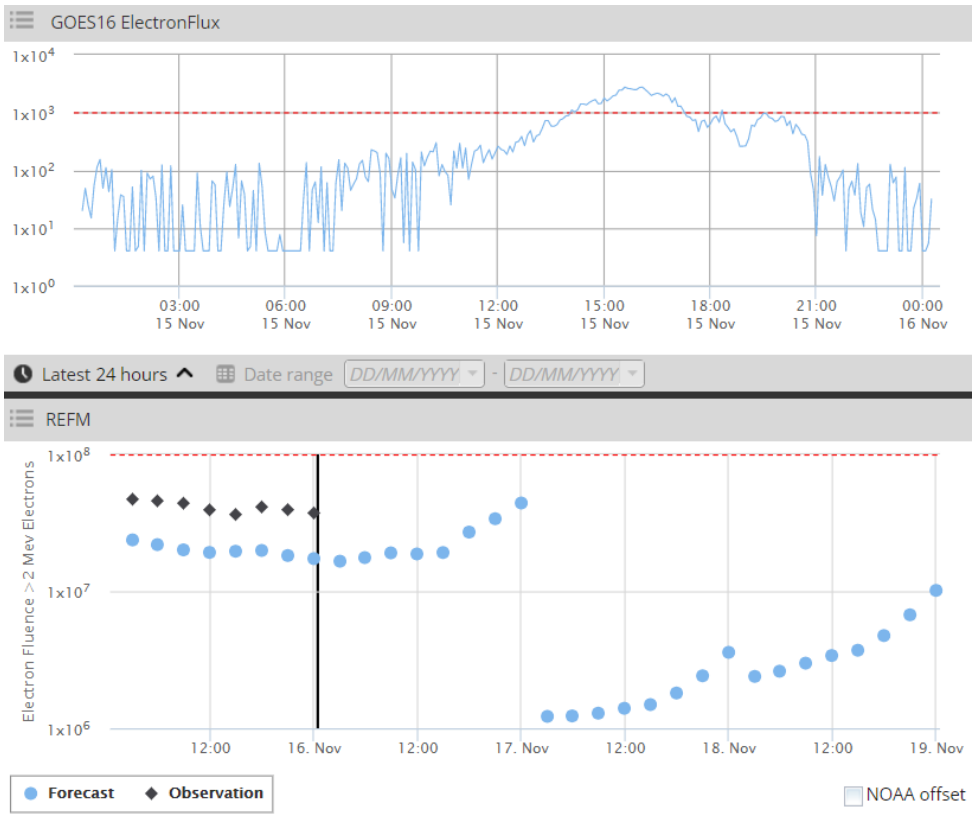
Figure 6: GOES-16 Electron Flux and REFM



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